

Analysis of controlled source electromagnetic data in the Black Sea: Regularized 2-D inversion with seismic constraints and trans-dimensional Bayesian inversion to estimate uncertainties

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In 2014 an interdisciplinary survey was conducted as part of the German SUGAR project in the Western Black Sea targeting gas hydrate occurrences in the Danube Delta. Marine controlled source electromagnetic (CSEM) data were acquired with a seafloor-towed horizontal dipole-dipole array. We present inversion results from two different approaches for one CSEM profile co-located with one seismic reflection profile from a high resolution 3-D data set. First, two-dimensional (2-D) regularised inversion (MARE2DEM by Kerry Key) is applied which provides a smooth model of the electrical resistivity distribution beneath the source and multiple receivers. The 2-D approach includes seafloor topography and structural constraints from seismic data. Second, trans-dimensional (trans-D) Bayesian inversion for a layered subsurface is carried out which treats the number of layers as unknown and rigorously estimates parameter uncertainty. To quantify parameter uncertainty, we consider one CSEM data location and apply trans-D inversion via reversible jump Markov-chain Monte Carlo (random) sampling. A non-diagonal data covariance matrix, obtained from residual error analysis, accounts for correlated errors. The thorough uncertainty analysis is relevant to estimate realistic upper and lower bounds on resistivities and subsequently on gas hydrate saturation along the profile.